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(54) IMPROVEMENTS RELATING TO NUT JOINTS

(71) We, COLD FASTENERS, INC., a corporation organised and existing under the laws of the Dominion of Canada, of 790 Ottawa Street, Windsor, Ontario, Canada, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a nut joint construction and more particularly to a method for making such a joint.

In automotive use and the like, it is common to attach weld nuts and pierce nuts to sheet metal parts to provide a means for fastening bolts, screws and the like.

According to the present invention, there is provided a method of forming a joint between a nut and a sheet metal plate, the nut comprising a tubular body which has a first tubular portion defining a riveting skirt, a second tubular portion having an internal screw thread, and a radially outwardly directed flange located at the end of the body remote from the riveting skirt, the second portion having a plurality of circumferentially spaced external ribs adjoining the flange and the first tubular portion having a larger opening than the second tubular portion, in which method the riveting skirt of the nut is brought into engagement with a portion of the plate surrounding an opening in the plate and the nut is pressed into the plate so that the riveting skirt deforms said plate portion into a neck and thereafter said second tubular portion of the nut body enters the neck to impress the ribs on said second tubular portion into the neck, and in which the riveting skirt is turned outwardly over the free end of the neck.

The invention is further described, by way of example, with reference to the accompanying drawings, in which:—

Fig. 1 is a part sectional elevation of an apparatus for forming a nut joint between a nut and a flat plate;

Fig. 2 is a view similar to Fig. 1 showing the parts of the apparatus in a different operative position;

Fig. 3 is a view similar to Fig. 2 showing the parts in another operative position;

Fig. 4 is a view similar to Fig. 3 showing the parts in a further operative position;

Fig. 5 is a view similar to Fig. 4 showing the parts in a still further operative position;

Fig. 6 is a part sectional elevation of a nut for use in a method according to the invention;

Fig. 7 is a bottom end view of the same;

Fig. 8 is a top end view of the same in a joint construction;

Fig. 9 is a part sectional elevation of a modified form of nut for use in a method according to the invention;

Fig. 10 is a bottom end view of the same;

Fig. 11 is a top end view of the same in a joint construction;

Fig. 12 is an enlarged view of a portion of the apparatus shown in Fig. 1;

Fig. 13 is an enlarged view of a portion of the apparatus shown in Fig. 2;

Fig. 14 is an enlarged view of a portion of the apparatus shown in Fig. 3;

Fig. 15 is an enlarged view of a portion of the apparatus shown in Fig. 4; and

Fig. 16 is an elevation partly in section of a joint between a nut and a flat plate.

Referring to Figs. 6 to 8, a nut 10 comprises a tubular body 11 having a non-circular flange 12. The flange shown is polygonal, in this case hexagonal, and extends radially outwardly at one end. The body has a first tubular portion 14 which defines a riveting skirt 15 and a second tubular portion 13*a* having an internal screw thread and a plurality of circumferentially spaced external ribs 16 adjoining the flange 12. Each rib has a substantially flat radially outer surface and a beveled lower end 17. The radially outer edge of the free end of the riveting skirt 15 is rounded as at 18, and this end has a sharp radially inner edge as at 19. The vertices or corners of the flange 12 are flattened as at 20, having been, for example, cut. Furthermore, the first tubular

portion 14 of the nut has a larger opening than the second tubular portion 13a and the axial length of the second tubular portion corresponds to the length of the ribs plus the thickness of the flange, the thickness of the flange being less than the length of the ribs.

As shown in Fig. 7, the minimum cross sectional dimension between opposite sides of the flange 12 is substantially equal to the maximum distance across the ribs 16 and the maximum spacing between opposite corners of the flange 12 is slightly greater than the corresponding distance across the ribs 16. The nut shown in Figs. 6 to 8 is intended to be used in connection with a flat sheet metal plate 21 having an opening 22 therein, as shown in Fig. 12.

In the form of nut shown in Figs. 9 to 11, the flange 12a is circular. In both types of nut the ribs 16, 16a are dimensioned and spaced to facilitate grasping the nut for threading and similar operations.

Referring to Fig. 1, the apparatus for forming the joint comprises a base 30 having a flat surface 31 and uprights 32 on which a first platen 33 is fixedly mounted. A second platen 34 is mounted on rods 85 so that it is movable towards and away from the first platen 33. The second platen 34 supports a pressure die 35 which has a flat surface 36 and an axial opening 37. A first plate 38 is supported on the first platen 33 and guided by guide pins 39. Springs 40 yieldingly urge the plate 38 upwardly away from the platen 33 to provide a space S1 therebetween.

A first die element 41 is mounted on the first plate 38 and includes a cylindrical opening 42, which extends through the die element 41, an upper surface 43 which is perpendicular to the wall of the opening 42 (Fig. 12) and a lower surface forming a stop. The upper end of the opening 42 is recessed as at 42a (Fig. 13) and may, in an alternative embodiment be inwardly tapered.

A second die element 44 extends upwardly through opening 42 and has the same diameter as the intermediate portion of the opening 42. At its lower end, the die element 44 is enlarged as at 45 while at the upper end it is formed with a locating pin 46 of reduced diameter. A flanging portion comprising a concave recess 47 is provided in the region where the lower end of the pin 46 meets the intermediate portion of the die element 44 (Fig. 13). The concave recess is preferably defined by an inclined frusto-conical wall portion 48 and an arcuate wall portion 49.

A second plate 50 is mounted on the undersurface of the platen 33 and is guided by guide pins 51. Springs 52 interposed between the heads of the guide pins 51 and the plate 50 yieldingly urge the plate 50 towards the platen 33.

A force transmitting member or shaft 53 is provided on the second plate 50 in alignment with the second die element 44. A spring 54 is interposed between the lower end 45 of the die element 44 and the bottom of a recess 55 in the first platen 33 and yieldingly urges the second die element 44 upwardly against the stop provided by the lower surface of the first die element 41 and away from the upper end of the force transmitting member 53 so that there is a space S2 therebetween.

In operation, as shown in Figs. 1 and 12, the metal sheet or plate 21 is arranged so that the pin 46 is received in the opening 22 and the nut 10 is placed over the pin 46 with its lower end engaging the sheet. Platen 34 is then lowered in one continuous movement.

Initially, as shown in Figs. 2 and 13, the riveting skirt of the nut 10 engages the portion of the sheet which surrounds the pin 46 and which is interposed between the opening 22 and the upper end of the die element 41 to deform the sheet into a neck whose periphery is spaced from the wall of the opening 42. Alternatively the wall of the opening 42 may be arranged such that the end of the neck is laterally confined and the portion intermediate the end and the remainder of the plate is unconfined at this stage. For example, the neck may be forced against the wall of the opening 42.

Continued movement of the platen 34 brings the die element 44 into engagement with the force transmitting member 53 thereby closing the space S2, as shown in Fig. 2.

Continued movement of the platen 34 completes the formation of the neck and brings the lower end of the nut into engagement with the frusto-conical wall portion of the recess 47 (Fig. 14) and the lower end of the force transmitting member 53 into engagement with the surface 31 of the base 30 as shown in Fig. 3. The lower or second plate 50 is thus displaced from engagement with the platen 33 against the action of the spring 52 to define a space S3.

Continued movement of the platen 34 causes the second tubular portion of the nut body to enter the neck so as to impress the ribs into the neck and deforms the riveting skirt of the nut outwards against the free end of the neck while countersinking the flange of the nut into the neck opening. Whilst the riveting skirt is being turned outwardly, it acts on the second die element 44, pressing the element 44 against the force transmitting member 53.

As shown in Figs. 4 and 15, in this final movement of the platen 34, the surface 36 of the pressure die 35 engages the upper surface of the plate, clamping the plate be-

tween the surface 36 and the surface 43, as well as applying a force to the nut flange.

Finally when the platen 34 is retracted, the force of the springs 52 acts on the force transmitting member 53 causing said member to push the pressure die 35 to eject the nut and plate.

The resultant joint comprises the flat portion of the plate 21 and an integral neck 57 connected to the flat portion of the plate by an intermediate section 58, of substantially constant curvature and rounded fillet-like shape which is spaced from the periphery of the flange 12 except at the corners 20. The lower edges of the corners 20 are cut into or deform parts of an upper portion 56 of the curved section 58 and the ribs 16 are impressed and cut into or deform parts of the neck 57 and lower portion of the curved section 58.

The resultant joint provides a strong connection capable of withstanding high torques between the nuts and the plate. As shown in Fig. 8, the corners 20 only slightly indent the metal plate and as shown in Fig. 15, the ribs indent the metal plates sufficiently to provide adequate retention against torques between the nut and the plate.

It has been found that a joint such as that shown and described is strong. Thus in a test wherein forces were applied in a variety of directions to the nut in the joint shown in Fig. 8, the following test results were noted:

Compressive Load applied to $^{5}/_{16}$" Allen Screw from end opposite neck from end adjacent neck 33—bending without failure at 1200 pounds.

Compressive Load applied axially to $^{5}/_{16}$" Allen Screw from end adjacent free end of neck 33—deflection of $^{6}/_{16}$ inches at load of 4500 pounds.

Compressive Load applied to $^{5}/_{16}$" Allen Screw from end opposites neck 33—500 pounds with no movement detected.

Repeated torquing of 35 foot pounds on nut of $^{5}/_{16}$" Allen Screw without movement.

In the modified form of the invention shown in Fig. 9, the flange 12*a* is circular rather than hexagonal. In this form, there are no corners on the flange so that the entire periphery is spaced from the upper surface of the plate and the lower edge of the flange does not indent the plate as in the other form of nut.

Thus, it can be seen that the invention can provide a method for making a joint, wherein high strength may be obtained with minimum metal, wherein excellent torque characteristics may be exhibited, wherein a nut may be readily located and properly positioned with respect to the metal part and wherein the same nut can be utilized for different gauge metal parts.

Attention is drawn to Applicaton No. 01412/77 (Serial No. 1,474,767), which has been divided out the present application and which describes and claims apparatus for making a nut joint construction.

WHAT WE CLAIM IS:—

1. A method of forming a joint between a nut and a sheet metal plate, the nut comprising a tubular body which has a first tubular portion defining a riveting skirt, a second tubular portion having an internal screw thread, and a radially outwardly directed flange located at the end of the body remote from the riveting skirt, the second tubular portion having a plurality of circumferentially spaced external ribs adjoining the flange, and the first tubular portion having a larger opening than the second tubular portion, in which method the riveting skirt of the nut is brought into engagement with a portion of the plate surrounding an opening in the plate and the nut is pressed into the plate so that the riveting skirt deforms said plate portion into a neck and thereafter said second tubular portion of the nut body enters the neck to impress the ribs on said second tubular portion into the neck, and in which the riveting skirt is turned outwardly over the free end of the neck.

2. A method as claimed in claim 1 in which the nut is pressed into the plate until the flange becomes countersunk into the surface of the plate remote from the neck.

3. A method as claimed in claim 1 or 2 in which the formation of the neck is so controlled that the plate and the neck formed thereon are interconnected by an intermediate curved section.

4. A method as claimed in claim 3 wherein the flange is impressed into the intermediate section.

5. A method as claimed in claim 1, 2, 3 or 4 in which the plate is supported on an annular surface with the annular surface encircling but spaced from the opening in the plate and the nut is positioned about the opening with the riveting skirt disposed against the surface of the plate remote from the annular surface and is then pressed into the plate by means of a pressure die which is urged relatively towards said annular surface.

6. A method as claimed in claim 5 in which a locating pin is received in the opening of the plate, the nut being placed over the pin to position said nut about the opening.

7. A method as claimed in claim 6 in which said annular surface is on a first die element and the pin extends from a second die element having a flanging portion, which flanging portion co-operates with the pressure die to turn the riveting skirt outwardly over the free end of the neck.

8. A method as claimed in claim 7 wherein the flanging portion comprises a concave recess surrounding the pin.

9. A method as claimed in claim 8 wherein the concave recess is defined by a frusto-conical wall portion and an arcuate wall portion.

10. A method as claimed in claim 7, 8 or 9 in which the second die element is movably located in the first die element and, to limit the movement of the second die element relative to the first die element, said first die element is provided with a stop.

11. A method as claimed in claim 10 wherein the second die element is located in a cylindrical bore in the first die element and one end of said bore defines a circular opening into which the plate portion is deformed by the riveting skirt to form the neck.

12. A method as claimed in any of claims 7 to 11 in which the second die element is yieldingly urged away from a force transmitting member aligned therewith and in which the second die element is pressed against the force transmitting member by the riveting skirt whilst said skirt is being turned outwardly.

13. A method as claimed in claim 12 in which the nut and plate are ejected after the joint has been formed under the action of the force transmitting member.

14. A method as claimed in claim 12 or 13 wherein the first die element is mounted on a first plate on a first, stationary, platen which is located on a base and the pressure die is mounted on a second platen which moves towards the first platen from a position spaced therefrom to press the nut into the metal plate.

15. A method as claimed in claim 14 in which the first plate is yieldingly urged away from the first platen towards the second platen and a second plate resiliently mounted on the first platen is yieldingly urged against said first platen.

16. A method as claimed in claim 15 wherein the force transmitting member is mounted on the second plate.

17. A method as claimed in claim 16 wherein the means yieldingly urging the second die element away from said force transmitting member is interposed between the first platen and the second die element.

18. A method as claimed in any preceding claim wherein the external ribs of the nut each have a substantially flat radially outer surface.

19. A method as claimed in any preceding claim in which the ends of the ribs remote from the flange are bevelled.

20. A method as claimed in any preceding claim in which the axial length of said second tubular portion of the nut body corresponds to the length of the ribs plus the thickness of the flange, the thickness of the flange being less than the length of the ribs.

21. A method as claimed in any preceding claim wherein the end of the skirt of the nut body remote from the flange has a rounded radially outer edge.

22. A method as claimed in any of claims 1 to 21 wherein the end of the skirt of the nut body remote from the flange has sharp radially inner edge.

23. A method as claimed in any preceding claim in which the flange of the nut body has a non-circular periphery.

24. A method as claimed in claim 23 wherein the flange is polygonal.

25. A method as claimed in claim 24 wherein the corners of the flange are flattened.

26. A method of forming a nut joint substantially as herein described with reference to the accompanying drawings.

27. A joint when produced by the method as claimed in any preceding claim.

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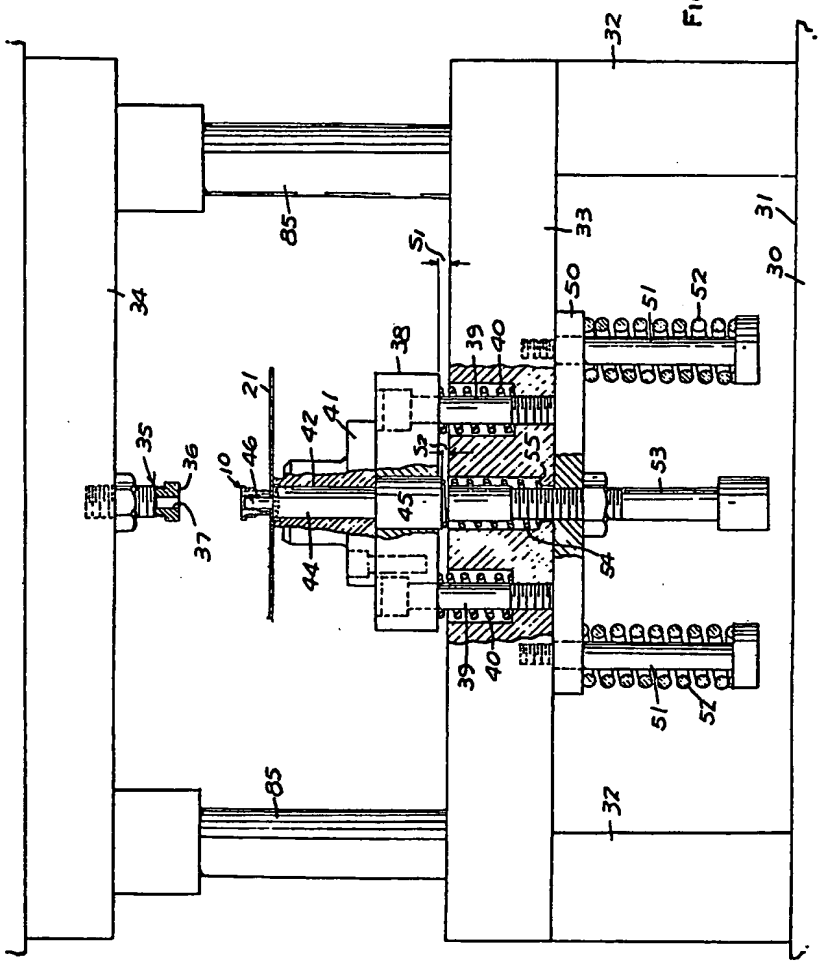
1474766 COMPLETE SPECIFICATION

7 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

FIG. 1



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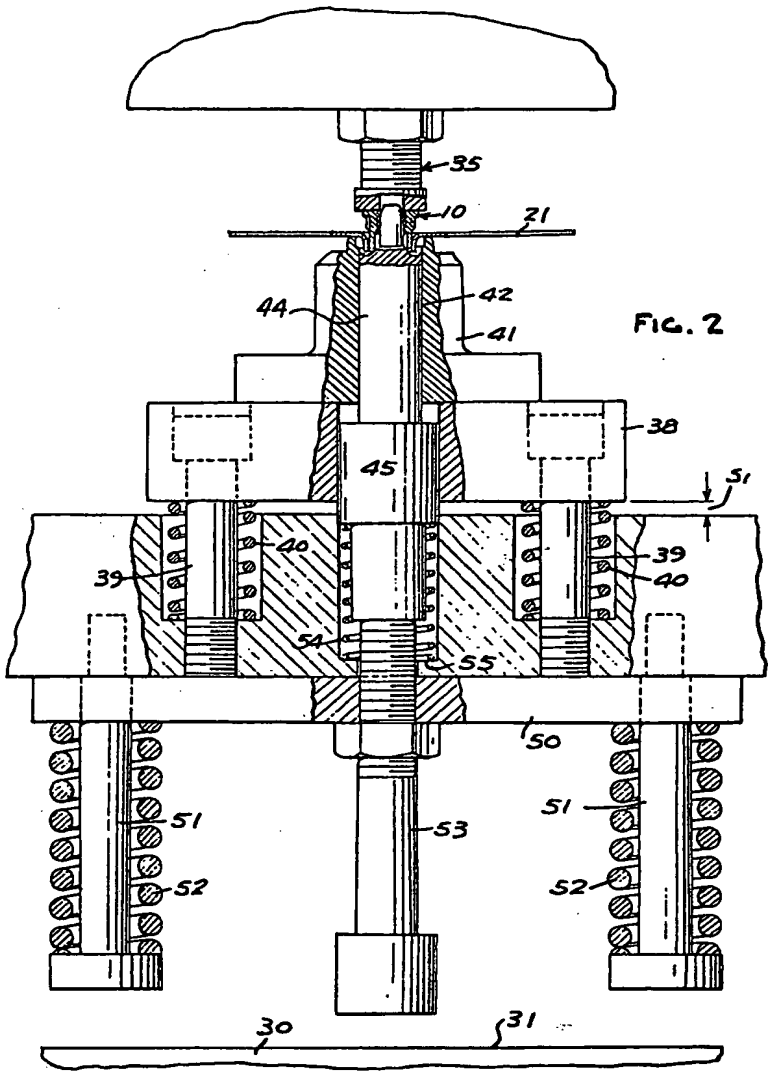

FIG. 2

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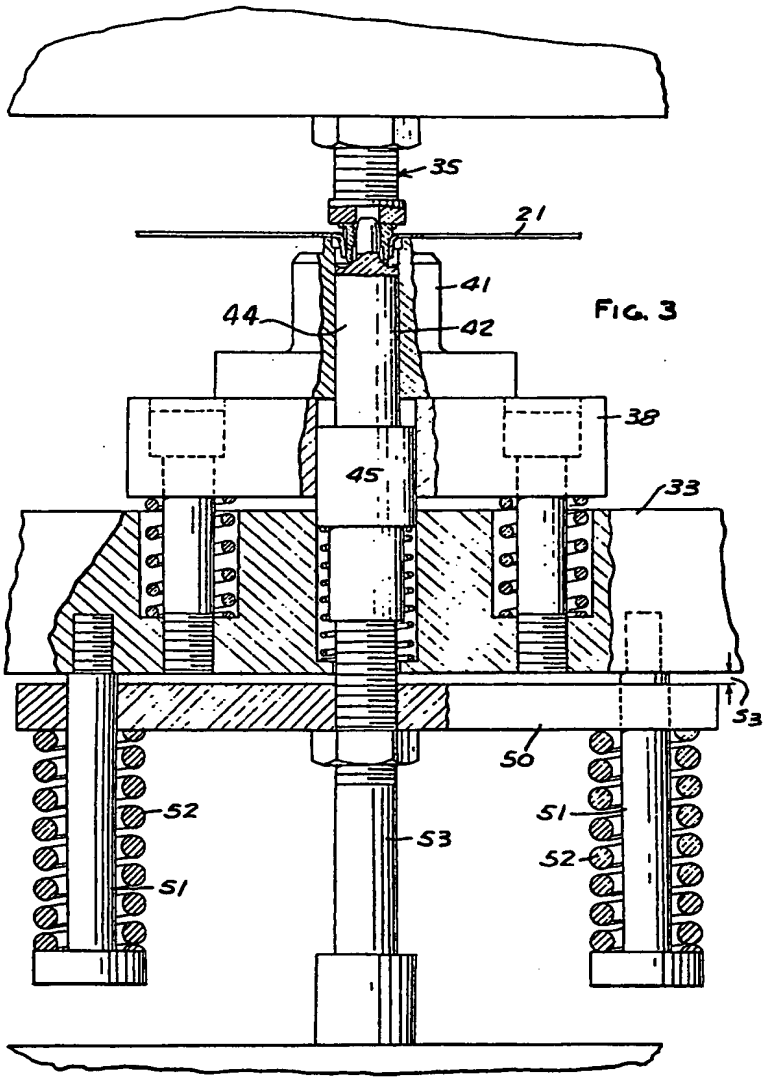

Fig. 3

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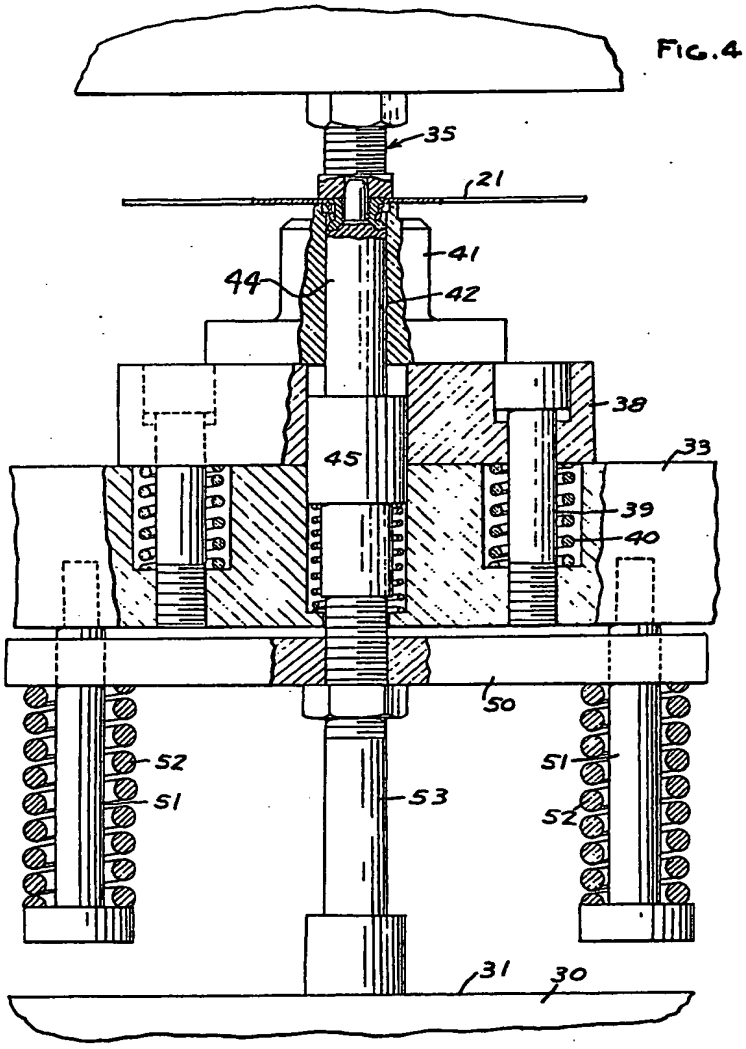
Sheet 4

FIG.4



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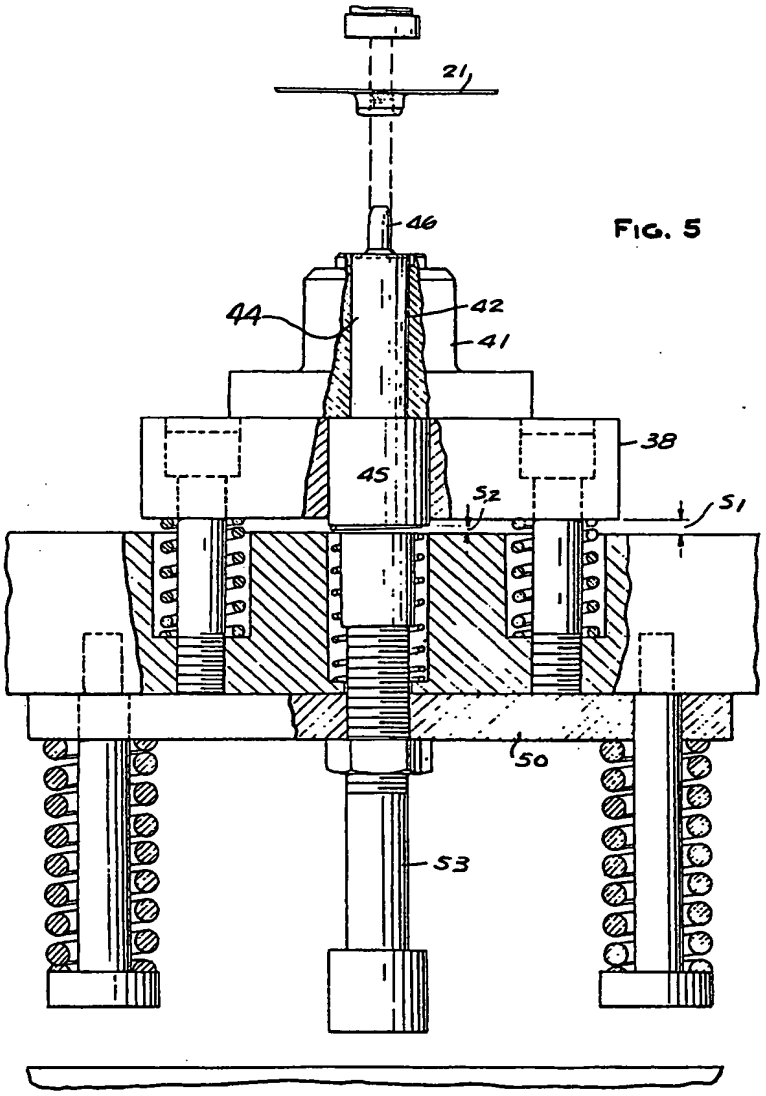

FIG. 5

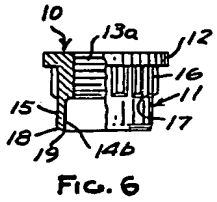

FIG. 6

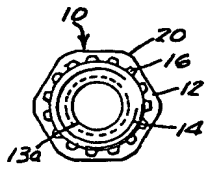

FIG. 7

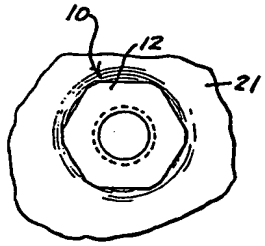

FIG. 8

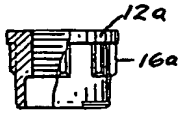

FIG. 9

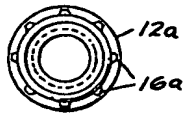

FIG. 10

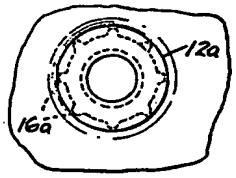

FIG. 11

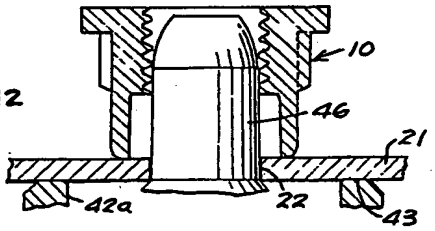

FIG. 12

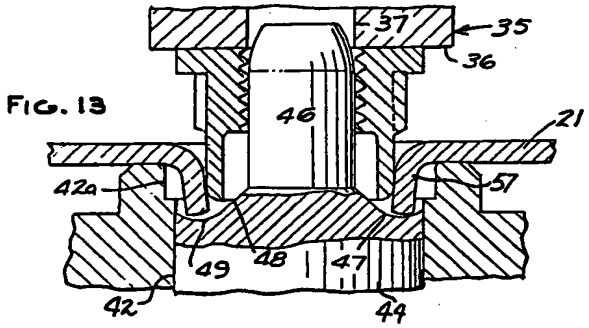

FIG. 13

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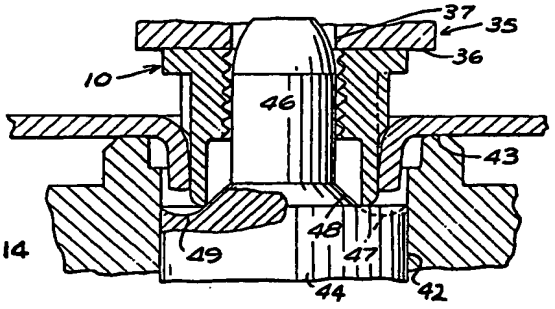

FIG. 14

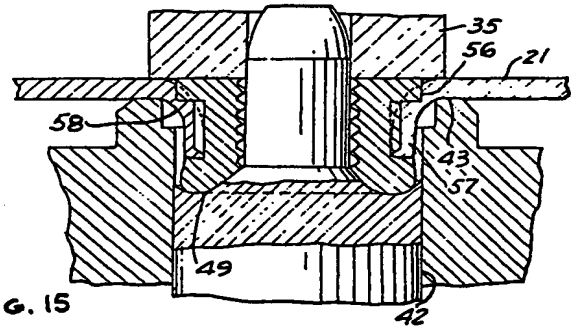

FIG. 15

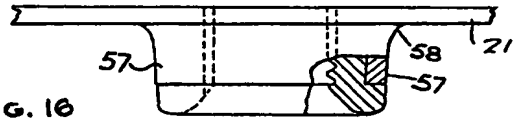

FIG. 16